

Test report No:
NIE: 66697RAN.001

Assessment report

RF EXPOSURE REPORT ACCORDING TO FCC 47 CFR Part 2.1091

(*) Identification of item under evaluation	LTE Cat-M Cellular communication module	
(*) Trademark	Sequans Communication	
(*) Model and /or type reference	GM02S	
(*) Other identification of the product	HW Version: GM02Sv1 SW Version: LR8.0.0.1-51281 FCC ID: 2AAGMGM02S IC: 12732A-GM02S IMEI TAC: 01577000	
(*) Features	LTE-M, 3GPP LTE Release 13	
(*) Manufacturer	SEQUANS COMMUNICATIONS 55 Boulevard Charles de Gaulle 92700 Colombes. France	
Test method requested, standard	FCC 47 CFR Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.	
Summary	IN COMPLIANCE	
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager	 MIGUEL LACAVE GARCÍA 2020.12.21 11:29:34 +01'00'
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Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested", "General description of the device").
2. Maximum output power

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Identification of the client

SEQUANS COMMUNICATIONS
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Document history

Report number	Date	Description
66697RAN.001	2020-12-21	First release

Appendix A: FCC RF Exposure assessment result

General description of the equipment under evaluation

The equipment under evaluation consists of a multi-band module supporting cellular LTE-M release 13.

As the equipment under evaluation is a module, a conservative evaluation distance of 20 cm has been used to perform the assessment.

The equipment specifications declared by the manufacturer for each supported technology and band are:

Technology / Mode	Band	Frequency (MHz)	Maximum Conducted Output Power RMS Burst (Incl. Tune-Up) (dBm)
LTE Cat-M1	2	1850 - 1910	23.00
LTE Cat-M1	4	1710 - 1755	23.00
LTE Cat-M1	12	699 - 716	23.00

Table 1: Equipment specifications

Maximum Antenna Gain determination for RF Exposure compliance

Summary of maximum antenna gain values:

Maximum antenna gain for mobile operation to comply with MPE and EIRP limits (see Appendix B) shall not exceed the following values:

Technology / Mode	Band	Frequency (MHz)	Max Gain to comply with MPE Limits (dBi)	Max Gain to comply with EIRP Limits (dBi)	Maximum allowed Gain (worst case) (dBi)
LTE Cat-M1	2	1850 - 1910	14.0	10.0	10.0
LTE Cat-M1	4	1710 - 1755	14.0	7.0	7.0
LTE Cat-M1	12	699 - 716	10.6	13.9	10.6

Table 2: Maximum Antenna Gain values

Maximum Gain to meet FCC Radiofrequency radiation exposure limits:

Technology / Mode	Band	Frequency (MHz)	Distance (cm)	Power density (mW/cm2)	FCC General Population Limit (mW/cm2)	Max Gain to meet MPE Limits (dBi)
LTE Cat-M1	2	1850 - 1910	20.0	0.04	1.0	14.0
LTE Cat-M1	4	1710 - 1755	20.0	0.04	1.0	14.0
LTE Cat-M1	12	699 - 716	20.0	0.04	0.5	10.6

Table 3: Maximum Antenna Gain values based on FCC MPE limits

Maximum Gain to meet FCC EIRP limits

Technology / Mode	Band	Frequency (MHz)	Max Conducted Output Power RMS Burst (Incl. Tune-Up)(dBm)	EIRP Limits (dBm)	Max Gain to meet EIRP Limits (dBi)
LTE Cat-M1	2	1850 - 1910	23.0	33.0	10.0
LTE Cat-M1	4	1710 - 1755	23.0	30.0	7.0
LTE Cat-M1	12	699 - 716	23.0	36.9	13.9

Table 4: Maximum Antenna Gain values based on FCC EIRP limits

Appendix B: FCC RF Exposure information

FCC RF Exposure evaluation

Devices operating in standalone mobile device exposure conditions may contain a single transmitter or multiple transmitters that do not transmit simultaneously. A minimum test separation distance ≥ 20 cm is required between the antenna and radiating structures of the device and nearby persons to apply mobile device exposure limits. The distance must be at least 20 cm and fully supported by the operating and installation configurations of the transmitter and its antenna(s), according to the source-based time-averaged maximum power requirements of § 2.1091(d)(2). In cases where cable losses or other attenuations are applied to determine compliance, the most conservative operating configurations and exposure conditions must be evaluated. The minimum test separation distance required for a device to comply with mobile device exposure conditions must be clearly identified in the installation and operating instructions, for all installation and exposure conditions, to enable users and installers to comply with RF exposure requirements. For mobile devices that have the potential to operate in portable device exposure conditions, similar to the configurations described in § 2.1091(d)(4), a KDB inquiry is required to determine the SAR test requirements for demonstrating compliance.

When a device qualifies for the categorical exclusion provision of § 2.1091(c), the minimum test separation distance may be estimated, when applicable, by simple calculations according to plane-wave equivalent conditions, to ensure the transmitter and its antenna(s) can operate in manners that meet or exceed the estimated distance. The source-based time-averaged maximum radiated power, according to the maximum antenna gain, must be applied to calculate the field strength and power density required to establish the minimum test separation distance. When the estimated test separation distance becomes overly conservative and does not support compliance, MPE measurement or computational modeling may be used to determine the required minimum separation distance.

According to §1.1310 Radiofrequency radiation exposure limits, paragraph (e), the limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields are:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3–3.0	614	1.63	* 100	6
3.0–30	1842/f	4.89/f	* 900/f ²	6
30–300	61.4	0.163	1.0	6
300–1,500			1/300	6
1,500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	* 100	30
1.34–30	824/f	2.19/f	* 180/f ²	30
30–300	27.5	0.073	0.2	30
300–1,500			1/1500	30
1,500–100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

FCC MPE Evaluation

Each supported transmission technology will be evaluated to determine if it is in compliance with limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

In order to perform the assessment, the following equations have been used for the calculations; these equations are accurate in the far-field of an antenna and will over-predict power density in the near field, where they could be used for making a "worst-case" or conservative prediction:

$$\text{Power density: } S[mW/cm^2] = \frac{P_{\max}[mW]}{4\pi R[cm]^2}$$

$$\text{Maximum gain to meet the MPE limit: } G_{\max}[dBi] = (10 * \log[S[mW/cm^2] * 4\pi R[cm]^2) - P_{\max}[dBm]$$

S = power density

$P_{\max}$ = power input to the antenna

R = distance to the center of radiation of the antenna (evaluation distance)

$G_{\max}$ = power gain of the antenna in the direction of interest relative to an isotropic radiator

FCC EIRP Limits

Maximum FCC EIRP limits are frequency-dependent and are stated into the FCC standards shown in the following table:

Standard	Frequency Band	Technology & Band	EIRP limit (W)	EIRP limit (dBm)
FCC 47 CFR §27.50 (c)	700	LTE 12, LTE 17, LTE 71, LTE 85	4.92	36.92
FCC 47 CFR §27.50 (b)	700	LTE 13	4.92	36.92
FCC Clause 90.542 (a) (7)	700	LTE 14	4.92	36.92
FCC 47 CFR §22.913	850	GSM 850, UMTS V, LTE 5/26	11.48	40.6
FCC 47 CFR §27.50 (d)	1700	WCDMA IV, LTE 4	1.0	30.0
FCC 47 CFR §24.232	1900	GSM 1900, UMTS 2, LTE 2/25	2.0	33.0
FCC 47 CFR §27.50 (a)	2300	LTE 30/40	0.25 (average EIRP)	23.9
FCC 47 CFR §27.50 (h) (2)	2600	LTE 7/41	2.0	33.0